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Fuel Economy

We believe that generally speaking there is more scope for fuel economy in industry than in the home. So far as the foundry is concerned, the melting of steel and iron is carried out efficiently having regard to the potential waste consequent upon the necessity to remelt material if spoilt by over-economising in fuel. In recent years there has been a remarkable improvement in the efficiency of non-ferrous melting furnaces. It was a happy hunting ground for the furnace designer because but little attention had been paid to the question. This was due to the fact that a misjudgment in the purchase of the raw materials could nullify any benefit to be obtained from good melting practice. As an industry it is not yet fully organised from the employers' angle, and the problem of reaching and so helping the many small units is difficult, but is now being tackled. It is in the ancillary processes and non-manufacturing aspects where the major waste is taking place throughout the industry as a whole. Mould and core drying are not always carried out according to the latest concepts, especially for bedded-in work. Ladle preparation is far too often carried out with most primitive arrangements for their drying out. Fire buckets are lighted for the supposed object of heating the shop, when the real reason is that of water boiling for tea making. One foundry we know possesses a badly-situated, inefficient, rather smelly gas fire, which seems to be lit for no purpose whatsoever whenever we visit the place, no matter what the season! Another is drying moulds for a type of casting which most foundries would cast green. Amongst the many smaller concerns much fuel is wasted by lighting the cupola for quite small runs, instead of filling the floor and casting less frequently. Small runs involve exactly the same heat losses due to heating up the furnace lining as a long one. Before the war Germany was taking an intense interest in foundry fuel economy with the usual Teutonic thoroughness. It caused a temporary setback, because having found that Schmidt's foundry ran their melting plant extremely economically, that became the standard for the trade. Next they discovered Heinrich's concern used a minimum quantity of metal for runners and risers, and this, too, became a standard. Yet surprise reigned in official quarters when it was found that Schmidt's practice could not be married to Heinrich's, nor Heinrich's to Schmidt's, without resulting in heavy losses from waster castings. Personally, we believe that greater fuel economies could be achieved by the application of scientific principles to the running of castings than in any endeavour to reduce the fuel ratio in melting practice. Only recently we referred to the conversion of the "hot spot defect" to technical use, and this, in association with the intelligent application of barometric pressure, can effect much economy through the consistent production of sound castings using a reduced weight of "sprue," even though larger box parts are called for. In the near future we shall publish details of this outstanding piece of practical research work. Many executives are at the moment examining very carefully the fuel-using processes in operation in their works. Some of the larger concerns have appointed fuel officers to their staff, with beneficial results. In fuel conservation, however, it is probable that the onlooker "sees more of the game" and founders should welcome any co-operation they get from the visiting technicians of Government departments, employers' federations or technical institutes, for a myopic condition is prone to attack those who are nearest to places where waste or inefficiency is taking place. In the long run, this drive for fuel economy will confer great benefits on British industry, which for so long has been favoured by ample and cheap supplies.

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CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

TIPPED TOOLS

To the Editor of THE FOUNDRY TRADE JOURNAL.

Sir,—May I be permitted to correct an error in the report of my discussion on Mr. Blakiston's Paper on "High-Duty Grey-Iron Castings," which appears on page 55 of your issue of September 17?

In the first paragraph I am stated to have said that tungsten carbide tips were not satisfactory for use in electric resistance tipping machines. Actually, of course, tungsten carbide tips are regularly brazed to steel tool shanks using such machines. The point of my remarks in the discussion was, however, that when cast iron is used in place of steel for shanks, then trouble frequently arises if brazing is carried out with the resistance tipper. This trouble is clearly due to the higher electrical resistance of cast iron and its lower melting point, which result in the melting of the metal at the end of the shank to be tipped. It should be remembered, therefore, that where cast iron tool shanks are adopted, then the brazing of the tip should be carried out in muffle furnaces and not on the resistance type of machine. I hope that this makes this matter quite clear.—Yours, etc.,

ARTHUR B. EVEREST.

The Mond Nickel Company, Limited,
Grosvenor House, Park Lane, W.1.
September 18, 1942.

BRASSFOUNDERS' EMPLOYERS' ASSOCIATION

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—You may be interested to know that at a recent general meeting of the Brassfounders' Employers' Association it was announced that during the last twelve months the membership of the Association has increased by 50 per cent. The Association is not only a Birmingham affair, although the trade is preponderantly Midland, but has members all over the country, in Lancashire, Yorkshire, Scotland, London, and the South, as well as the Midlands.—Yours, etc.,

EDGAR N. HILEY,
Secretary.

The Brassfounders' Employers' Association,
106, Edmund Street,
Birmingham, 3.
September 18, 1942.

INSTITUTE OF BRITISH FOUNDRYMEN

ESSAY COMPETITION

The results of the Essay Competition on "The Future of the Foundry Industry in Great Britain," organised by the I.B.F. earlier in the year, have now been announced as follow:—

1st Prize: A. H. Squire, Associate Member, Birmingham Branch.

2nd Prize: R. Horton, Associate Member, East Midlands Branch, Lincoln Section.

3rd Prize: A. Marson, Associate Member, unattached.

IRON AND STEEL INSTITUTE

JOINT MEETINGS

Arrangements have been made for a joint meeting of the Manchester Metallurgical Society and the Iron and Steel Institute to be held on Wednesday, September 30, at 6.30 p.m., at the Engineers' Club, Albert Square, Manchester. Mr. J. Sinclair Kerr (member of Council of the Iron and Steel Institute) will preside, and Prof. J. H. Andrew will present the Paper by himself and Dr. H. Lee entitled "The Work-Hardening and Ageing of Steel."

A joint meeting of the Sheffield Society of Engineers and Metallurgists, the Sheffield Metallurgical Association and the Iron and Steel Institute will be held at the Royal Victoria Station Hotel, Sheffield, on Saturday, October 24, at 2.30 p.m. Dr. W. H. Hatfield, F.R.S. (Vice-President of the Iron and Steel Institute, President of the Sheffield Society of Engineers and Metallurgists) will take the chair.

The following Papers will be presented for discussion: "The Formation of Hair-Line Cracks—Part I," by Prof. J. H. Andrew, D.Sc., A. K. Bose, B.Met., G. A. Geach, M.Sc., Ph.D., and H. Lee, B.Eng., Ph.D.; "The Determination of the Solubility of Hydrogen in Iron and Iron Alloys," by Prof. J. H. Andrew, D.Sc., H. Lee, B.Eng., Ph.D., and A. G. Quarrell, B.Sc., Ph.D. These Papers will be issued in preprint form on September 28. Members who do not receive preprints can obtain copies on application to the Institute.

Invitations from Sheffield Technical Societies

The Sheffield Society of Engineers and Metallurgists and the Sheffield Metallurgical Association have extended cordial invitations to members of the Iron and Steel Institute to take part in the following meetings:—

Sheffield Society of Engineers and Metallurgists, Saturday, September 26, at the Royal Victoria Station Hotel, Sheffield, at 2.30 p.m. Dr. W. H. Hatfield, F.R.S., will preside and Dr. H. Sutton (Royal Aircraft Establishment, Farnborough) will give a lecture on "Steels in German Aero Engines and Aircraft."

Sheffield Metallurgical Association, Saturday, October 10, at 198, West Street, Sheffield, at 2.30 p.m. Dr. E. Gregory (President of the Sheffield Metallurgical Association) will preside and there will be an address on "The Rationalisation of Specifications to Meet Wartime Needs," by Dr. W. H. Hatfield, F.R.S.

Sheffield Society of Engineers and Metallurgists, Saturday, December 12, at the Royal Victoria Station Hotel, Sheffield, at 2.30 p.m., when there will be a lecture on the "Economic Utilisation of Alloy-Steel Scrap in Steelworks," by Mr. H. Bull (Brown Bayley's Steel Works, Limited, Sheffield). Dr. W. H. Hatfield will be in the chair.

By the beginning of July, the United States Steel Corporation produced its millionth bomb shell, had delivered more than 5,000,000 pieces of ordnance, had erected steelwork for a new aircraft plant in 53 days, had built a destroyer in less than eight months against 20 months normal time, and had turned out enough steel plates in May for 100 ships, with the increase over March enough for 12 ships.

PRACTICAL ECONOMIES IN THE USE OF COREBINDERS

Natural Bonded Sand—Use of Recovered Core Sand—Baking Practice—Storage of Dried Cores—Control and Testing of Corebinders

By A. TIPPER, M.Sc.(Eng.).

(*Continued from page* 31.)

Naturally Bonded Sand

The use of naturally bonded sand may be advocated for two main reasons: (1) It produces green strength, therefore reducing the amount of starch or dextrine, etc., required to produce adequate bond; and (2) it produces a better finish on the core and resists metal penetration better than the straight silica sand core. Whilst increasing green bond, the addition of naturally bonded sand decreases dry strength for a given proportion of binder, and the amount of oil or binder required for a given dry strength must be increased appreciably (see Fig. 3). It also reduces the moisture resistance of the dried core as well as reducing permeability to some extent and in general the additions of naturally bonded sand should be kept to a minimum except in special cases—as, for example, in making cores for phosphor-bronze castings.

There is a very marked effect on dry strength when using additions of a fine red moulding sand such as Mansfield, but with particular mixtures (as, for example, when using molasses and linseed oil) the addition of 10 per cent. of naturally bonded sand gives a better finish to the core and less trouble in cleaning of the coreboxes on blowing machines. As an alternative to naturally bonded sand, bentonite, colbond, or fullers earth, can be used quite successfully to increase green strength without affecting permeability, provided

TABLE III.—*Typical Core Mixtures Containing Clay or Clay Bonded Sand.*

Mix No.	Application.	Proportions.		
		Sand.	Binder.	Added water.
1	Alloy steel castings	400 lbs. Chelford Silica 3½ lbs. Bentonite.	7 lbs. dextrine. 5 pints linseed oil.	3—4 pints.
2	General steel castings.	330 Leighton Buzzard, medium. 70 York Yellow	14 lbs. paste compound.	½ pint.
3	High quality C.I. engineering castings.	360 lbs. Sea Sand. 40 lbs. Fine Red or Loam Sand.	5 lbs. dextrine. 4 pints thin oil. 3 lbs. molasses.	1—1½ pints.
4	Cast-iron gear box cores.	320 lbs. Undried Silica Sand. 80 lbs. Moist Red Sand.	8—9 lbs. core powder. 3 pints thin oil.	Varies.
5	Cylinder block moulds and cores, C.I.	400 lbs. Sea Sand. 2 lbs. Bentonite.	6 lbs. dextrine. 3 pints raw linseed oil.	2—3 pints.
6	Bronze valves and pressure fittings	220 lbs. Sea Sand. 100 lbs. Mansfield Red. 80 lbs. Ryarsh Silica.	5 lbs. corepowder. 5 pints raw linseed oil.	4—5 pints.
7	General brass and bronze (also core machines).	340 lbs. Sea Sand. 60 lbs. Moist Red Sand.	10 lbs. paste compound. 3 pints thin oil.	Trace.
8	General brass and bronze (also core machines). Higher permeability sand.	400 lbs. Chelford or Sea Sand. 4 lbs. Bentonite.	7 lbs. core gum. 3 pints linseed oil.	4 pints.

Unless otherwise stated, all silica sands in above mixtures are used dry.

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that a suitable water addition is also made. Examples from practice of typical mixtures containing binding clay or natural sand additions are given in Table III. As to the supplies of silica sand, it is as well occasionally to test for silt or dirt content; loss on ignition and grading by sieve tests, and a sand containing gas-forming matter such as sea shell fragments, weed or sea coal should be avoided.

Use of Recovered Core Sand

For cores which require to be strong, permeable and to contain as little gas-forming matter as possible, the use of recovered core sand is not economical unless it is specially cleaned. Old core sand contains much of the unburnt or partially burnt binder clinging firmly to the sand grains, together with certain proportions of fines or clay bond if naturally bonded sand is used in the core mixture, and the use of even a moderate proportion of such sand with new silica sand will usually lead to: (1) Increased gas content of the cores; (2) lower permeability; and (3) a higher percentage addition of oil or binder to obtain the required dry strength.

Green bond is often improved slightly by the use of old core sand but this does not warrant its use except for additions to the moulding system or for unimportant block cores. There are numerous instances where cores can be used for less important jobs, such as backing up or outside cores in dry sand or oil sand moulds as used for cylinder block castings, and a number of foundries make use of the old core sand in this way, milling it with a small addition of a cheap binder and water as required. These types of cores need not possess great strength and the addition of from 1 to 2 per cent. of molasses or wood extract, or about 1 per cent. of core gum should produce a workable mixture. In some cases mixtures of 100 per cent. recovered core sand are being used in this way, but the main problem of using recovered silica sand for general core-making calls for a specially designed cleaning plant in which the sand grains are freed from bond before being re-used.

Two systems of cleaning are now being used to a considerable extent. The first employs wet methods of scrubbing the sand, which passes through a classifier, before being dried, and produces a sand in some respects cleaner and more regularly graded than the original sand received in the foundry. This process, which forms part of the Hydroblast system of hydraulic cleaning of castings,* is now applied very successfully in a number of steelfoundries in America, and it is understood that in consequence of the improved cleanliness of the treated sand, lower percentages of binder can be used than with the new sand as received by the foundry. The dry method of recovering core sand as used by certain foundries in this country makes use of a furnace to burn out all remaining binders, the sand then being

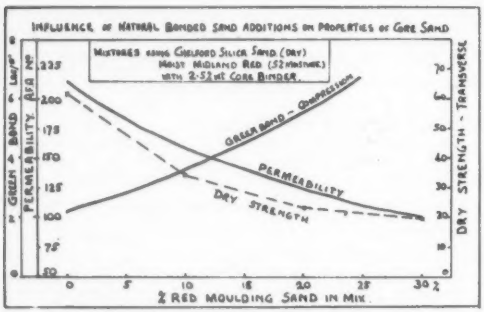
INFLUENCE OF NATURAL BONDED SAND ADDITIONS ON PROPERTIES OF CORE SAND
MIXTURES USING CHELFORD SILICA SAND (DRY)
MOIST MIDLAND RED (5% MOISTURE)
WITH 2·5% WT. CORE BINDER.
GREEN BOND - COMPRESSION
PERMEABILITY
DRY STRENGTH
GREEN & BOND - LBS/IN²
PERMEABILITY
DRY STRENGTH - TRANSVERSE
% RED MOULDING SAND IN MIX.

FIG. 3.—INFLUENCE OF NATURAL BONDED SAND ADDITIONS ON PROPERTIES OF CORE SAND.

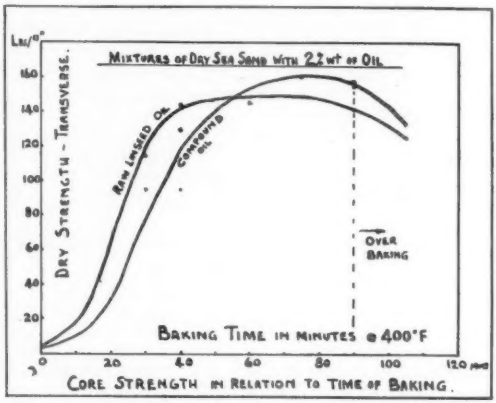
MIXTURES OF DRY SEA SAND WITH 2·2 WT % OIL
RAW LINSEED OIL
COMPOUNDED OIL
DRY STRENGTH - TRANSVERSE.
OVER BAKING
BAKING TIME IN MINUTES @ 400°F
CORE STRENGTH IN RELATION TO TIME OF BAKING.

FIG. 4.—CORE STRENGTH IN RELATION TO TIME OF BAKING FOR MIXTURES OF DRY SEA SAND WITH 2 PER CENT. BY WEIGHT OF OIL.

* "Foundry Trade Journal," February 19, 1942, pp. 117-120.

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passed over screens or suitable cooling trays fitted with dust extraction apparatus to remove all fines and ash, etc., from the sand. The relatively expensive plant required limits the application of such cleaning systems to foundries using large quantities of oil-sand cores.

Baking Practice

This is considered as the most critical stage in successful core production, since, ignoring the effect of the percentage of binder present and type of sand used, the degree of baking of any

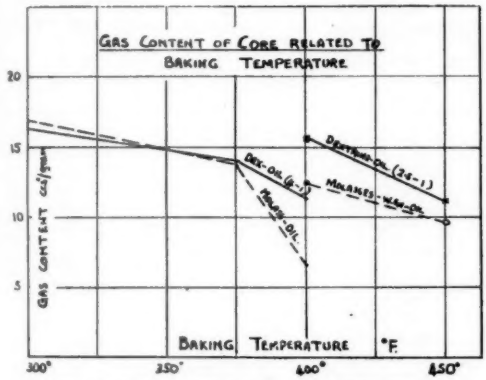

FIG. 5.—GAS CONTENT OF CORE RELATED TO BAKING TEMPERATURE.

oil-sand core controls the mechanical strength of the core, its moisture resistance, and the volume of gas evolved when the core is used. The relationship between time of baking and core strength for two typical core oils used with sea sand is shown in Fig. 4. The baking temperature was maintained at 400 deg. F. ± 5 deg. for the whole period, and it is evident that the compounded oil requires a longer baking period or alternatively a higher baking temperature than linseed oil. In actual practice this oil is normally baked at approximately 450 deg. F. Underbaking of cores results in low dry strength, poor moisture resistance and a high gas content, whilst overbaking gives weak friable cores but lowest gas content.

The influence of both time and temperature on the core strength and gas content of oil-bonded cores was very clearly shown in a series of curves included in a Paper by H. W. Dietert and F. Valtier on "Controlling Properties of Cores,"* to which interested readers are referred. Fig. 5 shows some of the authors' results contrasting molasses and dextrine under similar conditions of baking, proportions, etc. The correct baking temperature to use depends on the type of binder being used (see Fig. 1) and on the general stove conditions, whilst time of baking is largely a matter of bulk or section thickness of the core. As a rough guide, a baking time of 1 hr. per in. cross-section thickness of core is required for complete baking with sea sand cores. Much will, of course, depend on the shape of core, and the volume and heat capacity of the stove in relation to the load of cores, to be baked.

Other factors which tend to increase the time required for full baking of oil-sand cores are:

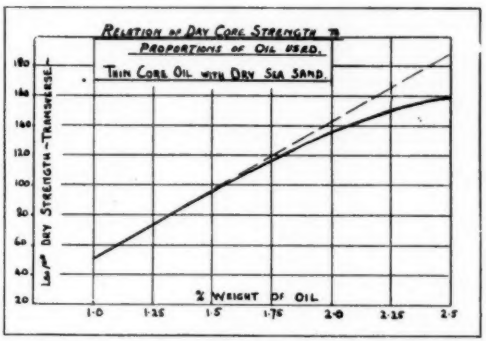

FIG. 6.—RELATION OF DRY CORE STRENGTH TO PROPORTIONS OF OIL USED.

(1) Sand of low permeability, *i.e.*, fine grained sand or sand containing appreciable fines, silt or clay; (2) a higher percentage of binder; (3) presence of non-drying oils, fuel oil, cotton seed oil, etc.; and (4) use of solid core plates or close packing of cores. For rapid baking there should be free access of hot air in the stove to all sides of the core, and movement of cores (as in a continuous drying stove) or circulation of the atmosphere inside the stove is a decided help in promoting uniformity and rapidity of baking. There should be a slight positive pressure inside the stove and if several stoves are connected to a common flue, they should be designed so that there is an equal pull on each stove.

The question of oxygen required for baking of oil sand is often mentioned and the necessity for

* "The Foundry," April, 1933, p. 18.

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TABLE IV.

Binder.	Gas content evolved at 800 deg. C., cms.³ per gram of core.	Oxygen required in baking, cms.³ per gram of core.
Concentrated wood extract ..	4.5	—
Molasses—R.L.O. mixture ..	7.4	—
D.-O.-W. cream	8.9	1.8
D.-O.-W. paste	11.4	2.35
Starch core powder	12.6	—
Raw linseed oil	14.5	7.5
Proportion of binder used ..	3 per cent. weight in each case.	2 per cent. weight in each case.

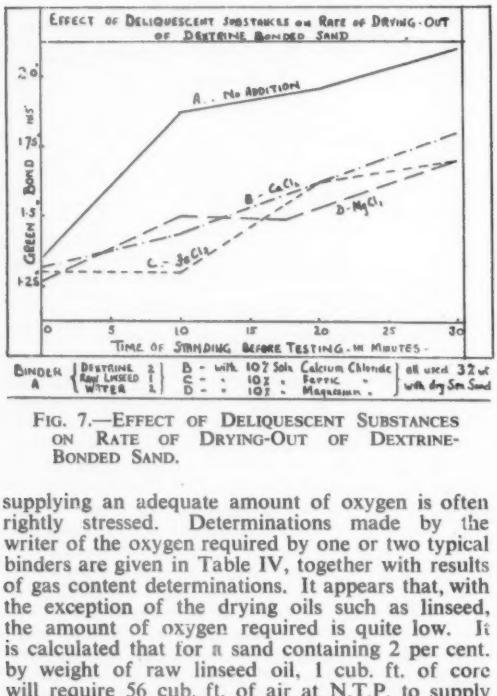

FIG. 7.—EFFECT OF DELIQUESCENT SUBSTANCES ON RATE OF DRYING-OUT OF DEXTRINE-BONDED SAND.

supplying an adequate amount of oxygen is often rightly stressed. Determinations made by the writer of the oxygen required by one or two typical binders are given in Table IV, together with results of gas content determinations. It appears that, with the exception of the drying oils such as linseed, the amount of oxygen required is quite low. It is calculated that for a sand containing 2 per cent. by weight of raw linseed oil, 1 cub. ft. of core will require 56 cub. ft. of air at N.T.P. to supply the minimum amount of oxygen (provided no oxygen is lost or consumed in heating) consumed during complete baking, which is rarely accomplished in practice. Assuming a stove in which the load of cores occupies 1/5th the total volume, this means a minimum of 11 complete changes of air during the period of baking. With a paste type of binder only about one-third as much air is required and once the core attains the necessary temperature baking proceeds rapidly with evaporation of moisture and volatile constituents, such as light oil fractions, etc. Baking conditions must therefore be adjusted wherever possible to suit the type of binder being used, in order to obtain good results.

Dry-Strength and Gas Content

The dry-strength and gas content of a baked core increases in proportion to the amount of binder present up to a point at which the sand becomes saturated or completely coated with bond

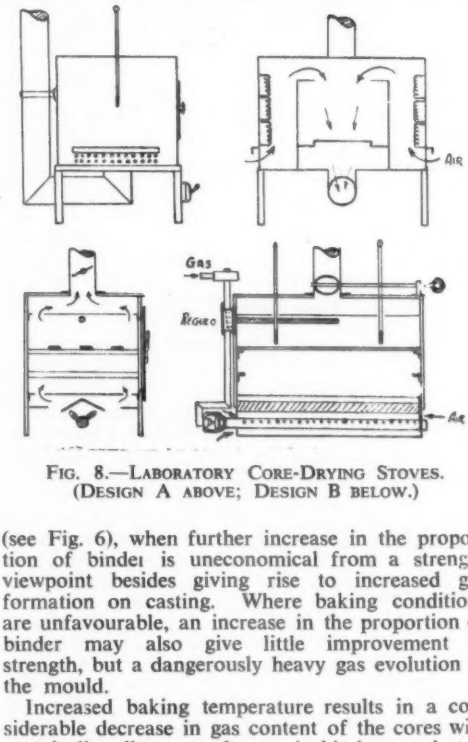

FIG. 8.—LABORATORY CORE-DRYING STOVES. (DESIGN A ABOVE; DESIGN B BELOW.)

(see Fig. 6), when further increase in the proportion of binder is uneconomical from a strength viewpoint besides giving rise to increased gas formation on casting. Where baking conditions are unfavourable, an increase in the proportion of binder may also give little improvement in strength, but a dangerously heavy gas evolution in the mould.

Increased baking temperature results in a considerable decrease in gas content of the cores with practically all types of organic binders, and it is therefore good policy to use the highest temperature practicable, although care is necessary in the

case of such binders as starch, dextrine and wood extract, which are susceptible to burning at temperatures over 370 to 400 deg. F. In drying small and medium sized cores there is often a considerable loss of stove efficiency due to door-opening for charging and discharging. This is overcome in modern stove design by: (1) The vertical continuous conveyor system; (2) a pusher-type carriage system; or (3) the tray or drawer type stove for small cores. A small continuous belt type oven, using a wire mesh belt might well be used for mass production baking of small cores.

Storage of Dried Cores

In practice baked cores are never 100 per cent waterproof, they will always absorb moisture from the air under the usual atmospheric conditions in

TABLE V.—*Testing Corebinders for Purity, Uniformity, and Comparative Value.*

CHEMICAL TESTS.	PHYSICAL TESTS.
Moisture content. Mineral ash, acid value. Iodine value. Saponification value. Special identification tests.	Stability and appearance. Specific gravity. Viscosity. Flash or fire point.

PRACTICAL CORE TESTS ON STANDARD SAND MIXTURES.

Green Bond.—Compression, overhang or shear.
Dry strength.—Tensile, transverse or compression.
Moisture resistance.—Effect on dry strength.
Gas content.—Influence of baking temperature and time.
Permeability.—Hardness.

this country, with consequent softening and reduction in strength. The degree of waterproofing depends largely on the proportion of moisture resisting agents such as resin, pitch or oil used. Water-soluble binders give little or no protection and may even be hygroscopic, whilst the presence of naturally bonded sand reduces the effectiveness of oil additions to impart moisture resistance. Provision should therefore be made for storage of baked cores in a warm dry atmosphere. Alternatively they may be warmed up before use where they are kept in stock for any length of time after baking.

Control of Air Drying of Mixed Core Sand

Considerable wastage of mixed sand, particularly with dextrine-bonded sand, can occur through drying out on the bench, etc. The loss of moisture which results in the sand losing its plasticity can be retarded by: (1) The addition of deliquescent substances (usually chlorides or nitrites); (2) by increasing the humidity of the atmosphere in the coreshop; (3) by enclosing the mixed sand in containers, covering with damp sacking, etc.; and (4) by reducing the permeability of openness of the

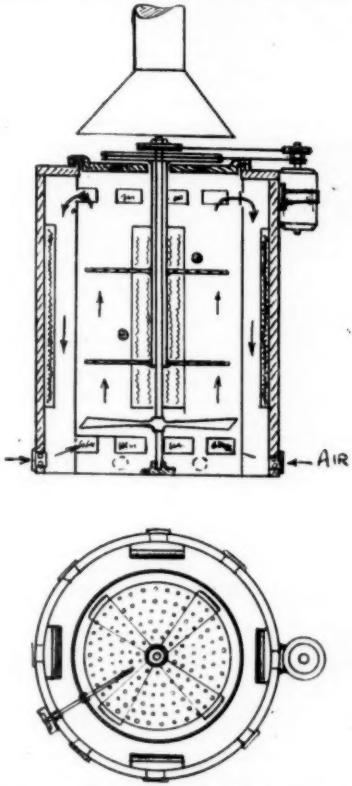

FIG. 9.—ROTATING SHELF-TYPE DRYING STOVE. (DESIGN C.)

sand with additions of fine-grained sand, as in the case of mixtures containing a proportion of naturally bonded sand. The results of a series of comparative tests with chlorides of calcium, magnesium and iron are plotted in Fig. 7, using the same basic core mixture in each case. It will be seen that there is not a great deal of difference in the influence of these chemicals on the rate of

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drying out, which was measured by the increase in green strength of a rammed core on standing for various times before testing. A slight reduction in dry strength was experienced in these mixtures containing chlorides. In practice, continued use of such additions may have a cumulative effect in other directions, and for this reason must be used with discretion. At the same time the presence of some form of sugar, such as crude molasses or glucose appears to serve to a limited extent a similar purpose, in reducing the rate of air-hardening of dextrine bonded mixtures.

Control and Testing of Corebinders

A brief classification of testing is set out in Table V, and may be divided into purely laboratory tests and those which may be carried out under more or less practical conditions in the foundry. Comprehensive information on the characteristics of seed oils, and methods of analysis will be found in the "Technical Handbook of Oils, Fats and Waxes," by Fryer and Weston, or in the "Chemical Technology and Analysis of Oils, Fats and Waxes," by Lewkowitsch and Warburton (3 vols.), to which students should refer. Tests on the corebinding materials by the laboratory will reveal any obvious variations in quality, excessive moisture content or mineral ash, and adulteration of seed oils, whilst routine tests on the prepared core sand will show variations in bonding value, green and dry strengths, etc. A series of oven tests will also give valuable information on the baking characteristics of any particular mixture and either the shop stove or a properly designed laboratory oven should be used. Figs. 8 and 9 show three types of laboratory drying stove; design A is that of Mr. W. Y. Buchanan, whilst design B has been used by the author with good results.

For dry strength testing of oil sands, the author prefers the tensile or transverse test and the tensile test-piece can be conveniently rammed on the A.F.A. standard ram fitted with a suitable shaped head.* It is as well to standardise on some regular graded core sand for test mixtures, such as Southport sea sand, and so reduce the variables to a minimum. Practical tests on prepared sand mixtures give valuable information on the working characteristics of the sand and are of great help in determining the most economical proportions of binder which can be used.

* See "Foundry Trade Journal," January 21, 1937, p. 85-86, for illustrations and description of recent developments in Testing Oil Sands, by N. D. Ridsdale, F.I.C.

As to the use of alternative materials, green bond may be obtained by the addition of a mineral clay, powdered wood extract, or a self-hardening compound such as silicon-ester or even waterglass, but the need for green bond can in many cases be removed by the use of suitable drying shells. In selecting a bonding clay, a type which has only moderate or low strength at high temperatures should be chosen. For dry strength, a simple thin oil-silica sand mixture may serve in which the proportion of oil can be as low as 1 per cent. by weight or less. The use of blended oil in place of pure linseed oil, using proportions of soya bean oil, nut oils, fish oils, and mineral oils containing resin, etc., helps to extend the available supplies of the drying oils, whilst residues from oil mills and refineries may be used with discretion where regularly available.

Conclusions

To summarise the outstanding factors in the best use of corebinders: Insure good mixing; use the cleanest and most regular sand possible; adopt regular and controlled baking conditions to suit the particular binders used; pay attention to storage conditions of cores; and carry out regular tests to secure uniformity of materials and consistent results in practice.

The author takes this opportunity of expressing his thanks to Mr. Morrogh, of the B.C.I.R.A., for his valuable assistance in preparation of slides, and to Mr. N. D. Ridsdale for the loan of lantern slides.

(Discussion to follow.)

THE LININGS OF LARGE BASIC OPEN-HEARTH TILTING FURNACES

Mr. A. Jackson, in a Paper dealing with the linings of large basic open-hearth tilting furnaces which he has prepared for presentation to the Iron and Steel Institute, has summarised his conclusions as follow:—(*a*) Magnesite and chrome-magnesite bricks are not of the same high quality as that attained about three years ago. (*b*) Chrome-magnesite bricks are probably still superior to magnesite for the linings of open-hearth tilting furnaces above the slag line. (*c*) Stabilised dolomite bricks can be used in part in the lower portions of the hearth to replace magnesite. They must be kept covered with fettling, or their life is poor. (*d*) Magnesite bricks are still the only satisfactory bricks for use about the slag line. (*e*) Stabilised dolomite cements may replace a reasonable portion of the chrome-magnesite cement used for lining maintenance, if present experiments in manufacture are successful. (*f*) The dolomite used for ordinary fettling must be fully shrunk and in good mechanical condition (suitable grading, etc.) to give the maximum reduction in consumption of magnesite and chrome materials.

Tentatively Recommended Practice for Sand-Cast Tin Bronzes

A.F.A. SUB-COMMITTEE'S REPORT

Extracts from a Report submitted to the Cleveland Convention of the American Foundrymen's Association

Introduction

For many years the proper classification for copper base alloys has been a problem for which a solution has been diligently sought. In 1939, the American Society for Testing Materials adopted Specification B119, entitled "Tentative Classification of Cast Copper Base Alloys." The specification was revised and now bears the designation B119-40T. Under the above classification, two types of tin-bronze alloys are defined. The first, designated as "tin-bronze," is defined as containing 2 to 20 per cent. tin with zinc less than tin and lead less than 0.5 per cent. The second is designated as "leaded tin-bronze" and is defined as containing up to 20 per cent. tin with zinc less than tin and lead over 0.5 per cent., but under 6 per cent.

Fundamental Metallurgy

As cast, the tin-bronzes consist of a solid solution matrix (with typical coring or dendritism) and an alpha-delta eutectoid which usually occurs as particles within the alpha solid solution matrix. The eutectoid consists of hard particles which appear light or bluish coloured under the microscope. At low magnification (× 100), the particles appear to be cellular in structure, but at higher magnifications (× 500 and up) they are shown to be composed of granular or spheroidal particles of the alpha constituent in a matrix of the delta.

Under equilibrium conditions, tin is soluble in solid copper up to about 16 per cent. at 550 deg. C. Prolonged annealing (ageing) at lower temperatures precipitates additional alpha-delta constituent, indicating a decreased solubility of the tin under equilibrium conditions. However, the dendritic segregation occurring during solidification (as in casting) promotes separation of the alpha-delta eutectoid at about 7 per cent. tin and over. In view of this fact, at 10 to 20 per cent. tin, a high percentage of the eutectoid is evident. The good bearing properties of these alloys are attributed to the hard precipitate structure in the softer solid solution matrix.

Moulding

(*a*) *Sands.*—A sand of about A.F.A. No. 2 grain size, D to F clay content, is suggested for these alloys, as most castings made of them must be smooth and clean. The sand must have sufficient bond strength so that it will not result in scabs and will lift well. For some work, it may be advisable to spray the mould surface with molasses water, with or without drying, to obtain best results.

It is well to determine the proper moisture content for the sand and then maintain this percentage within rather close limits. There are several ways in which moisture can be determined quite readily without extensive laboratory equipment.

More specifically, the following is the range of properties of sands to be used for castings made from these alloys:—Grain size A.F.A., 140 to 180; A.F.A. clay content, 5 to 20 per cent.; permeability, 10 to 25; green compressive strength, 7 to 9 lbs. per sq. in.; and moisture, 5 to 6 per cent. Proper sand conditioning is of enough importance to make it a routine which should be strictly followed. Thorough mixing with new sand, when necessary, and aeration of some sort are of prime importance.

(*b*) *Facing.*—It is not common practice to use facing sands, except in special cases. If the moulding sand used will meet the above requirements, it will be fine enough to impart a satisfactory smoothness to most castings. Facing materials, such as flour and plumbago, are sometimes used on the surface of the moulds—the former for small castings, the latter for large castings. For castings produced from metal containing appreciable amounts of phosphorus, plumbago coated moulds are sometimes used.

(*c*) *Gating and Risering.*—Gating and risering of castings made of these alloys is very important. A study of each particular class of castings should be made before deciding what type of gate is to be used. Risers or feeder heads are suggested on heavy sections. It may also be advisable to use a skimmer gate. For light, uniform-section castings, where rapid pouring is necessary to run them, a choke gate is recommended. There are many different kinds of gates and each of these should be given consideration when a difficult job presents itself. Gates should be made slightly heavier than on the red brasses, and risers are usually necessary on the larger castings. The risers must be of such size and so placed as to feed the castings and not freeze at the bottom so as to become ineffective. Make the sprue high enough to exert some pressure. Its size is also of great importance. Keep it full during the pour. Castings of the small uniform variety may best be gated by a simple brass or bronze type gate.

(*d*) *Cores.*—Fine silica sand and a good grade of core oil are suggested for cores for castings made from these alloys. The measured or weighed sand should be dry or all dried as a starting basis. If cores are too open, a small amount of shot-blast dust or silica flour may be introduced. As these core mixtures are weak and have low green strength, it will be necessary to use dryers in baking. When metal penetration is excessive, it may help to add 2 to 3 per cent. bentonite to the straight silica-oil core sand mixtures.

Baking temperature should be watched carefully and, if possible, be regulated automatically. A temperature of 230 deg. C. will take care of all classes of work, although it requires planning when different

A.S.T.M. Sand-Cast Tin Bronzes

sized cores are baked at the same time. The smaller and lighter work should be removed from the oven first, while the larger ones remain for longer periods. The ovens should be well ventilated, and equipped to distribute an even heat to all parts. Coating the cores with a thin layer of graphite, mica, or some other suitable wash, helps make the castings smoother on the inside. It is important to have strong, well-vented cores, as many castings in which these alloys are used, are intricate and have thin walls, so that considerable pressure is placed on the core when the metal is being poured. However, cores must not be too hard, otherwise core-blows, casting cracks and difficulty in core knockout may result.

Melting and Pouring

(*a*) *Types of Melting Equipment.*—Melting furnaces for use with the tin-bronze alloys may be heated with gas, fuel-oil, coke or electricity. Care must be taken in these furnaces to attain proper combustion and to prevent the products of combustion from coming into contact with the molten metal in so far as is possible. Best results are obtained when these alloys are melted under slightly oxidising atmospheres. Control of furnace atmosphere is important, and can be accomplished by analysing the combustion products with an Orsat or other recognised gas analysis equipment and adjusting conditions according to the results obtained.

The use of slow-melting furnaces should be avoided as this often results in maximum absorption of gas. The metal should be melted as rapidly as possible and raised only slightly over the necessary pouring temperature. Slight cooling adjustments can be made just prior to pouring the mould. Soaking the metal, *i.e.*, allowing it to remain in the furnace after it is ready to be poured, should be avoided. In natural-draft, pit furnaces, coke should be used for fuel to ensure quick melting. Experience has indicated that a mixture of coke and coal, or the use of coal alone, results in too slow melting and increased possibility of gas in the final castings.

(*b*) *Precautions.*—The temperatures of melting and pouring are of considerable importance. The metal should be poured at such temperatures as will give the best results for the given gating and risering as determined by trial. However, the temperature also should be high enough to avoid internal shrinkage, for many castings are so designed that shrinkage cannot be entirely eliminated by gating alone.

Metal should not be heated more than 50 deg. C. higher than the pouring temperature, as the higher the maximum temperature attained, the greater the tendency toward coarse and open grain structure, even though the metal be cooled to the proper temperature before pouring. A similar condition will result if metal is held in the molten state for a long time before pouring and the higher the holding temperature, the shorter the time required to produce inferior results. If the metal has been injured by overheating, it will be well to pour it into pigs and remelt it under proper conditions.

Accurate control of metal temperatures in the melting furnace and during pouring into the moulds is an essential part of foundry technique. For accurate results, the use of one of the standard type thermo-electric pyrometers, calibrated to cover the range of temperatures employed, is recommended. Pyrometers should be checked periodically with a standard instrument kept for this purpose only and it would be good insurance to be sure that this master instrument is correct.

(*c*) *Fluxing and Deoxidising.*—Fluxes are not particularly necessary, especially when good clean materials are used. A commonly used flux, to protect the metal in electric furnaces, is a mixture of 3 parts lime and 1 part fluorspar, but this flux or soda ash is hard on crucibles. For metal melted in crucibles, glass is a good flux. It is common practice to introduce a small percentage of phosphorus for deoxidising purposes, adding only enough to ensure complete deoxidisation of the metal and leaving a trace of phosphorus in the final alloy. In general, these alloys can stand higher residual phosphorus than the higher zinc alloys (0.02 to 0.03 per cent.).

Phosphorus is usually introduced through the medium of 15 per cent. phosphor-copper. It is customary to add 2 ozs. of 15 per cent. phosphor-copper per 100 lbs. of metal to perform this function. This is equivalent to approximately 0.02 per cent. of phosphorus. The phosphor-copper usually is added to the pouring ladle at the time the temperature is taken. This gives the phosphorus an interval for action before pouring. It is a good precaution to skim before adding the phosphor-copper. As phosphorus is increased, the metal becomes more fluid and an excess of phosphorus may increase the fluidity to such an extent that the metal will penetrate the mould and cores. High phosphorus also has a tendency to make dirty castings. The phosphor-bronzes are an exception to the above, as they require appropriate amounts of phosphorus and are often cast against a chill. The use of 1.00 per cent. nickel is permissible under A.S.T.M. Specifications B143-41T, B61-41. When nickel is added, it is customary to use 50-50 copper-nickel or thin electro-nickel squares for introducing it. For best results, melting under moderately oxidising atmosphere and final deoxidation with phosphorus is desirable.

(*d*) *Melting and Pouring Range.*—If these metals are alloyed in the foundry, the copper is melted first and heated to approximately 1,150 deg. C. Deoxidise with 2 ozs. of 15 per cent. phosphor-copper per 100 lbs. of molten metal before adding white metals. The necessary alloying elements are then added in the form of commercially pure metals. The alloying additions should be made gradually and in pieces of such size and shape that rapid solution will take place and the molten metal will not freeze. The metal should be stirred thoroughly after the alloying elements are completely melted.

In some types of electric furnaces all of the constituents of the melt are charged into the furnace at the

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beginning of the heat, even though 100 per cent. virgin metal is being used. No later additions are made, with the exception of phosphor-copper, which is best added in the ladle after pouring from the furnace. (See comment under phosphor-copper additions.)

If a certain percentage of foundry scrap is used in the melt, this material should be charged first, in crucible melting, to provide a heel of molten metal for the copper or alloy ingot. This procedure will shorten the melting time because pure copper melts at a higher temperature. Copper will melt somewhat more slowly as the ingots are relatively large. Copper-tin alloys require particular melting practice and close control, frequent analysis of scrap and castings produced being necessary.

The maximum temperature in the melting of the tin-bronze alloys should be no higher than that necessary to satisfactorily pour the castings. A pouring temperature within the range of 1,065 to 1,230 deg. C. is generally satisfactory for the majority of castings. In the case of castings of very thin sections, however, a temperature of 1,275 deg. C. may sometimes be necessary. In selecting the proper temperature, the effect of phosphorus and other elements on the fluidity should be kept in mind. Zinc should be added to replace that burned out in accordance with the individual furnace practice in each instance.

Finishing

Gates and risers usually are removed from the casting by a sprue cutter, the flash being removed later by grinding. Gates and risers also are removed by various other methods, such as by a band saw of suitable tooth design, operating at speeds from 200 to 500 or more ft. per min. and by abrasive wheels. Castings are usually cleaned by blasting and tumbling.

Chemical Control Limits

(*a*) *Variations in the Principal Elements.*—An increase in tin hardens the alloy, and decreases its ductility. Zinc has the same effect as tin, though to a lesser degree. Zinc also acts as a deoxidiser, though phosphorus is preferable when the alloys are to be used for bearings.

(*b*) *Effects of Impurities.*—(1) Phosphorus: Phosphorus, in excess of that required for deoxidation, increases the hardness and, in some cases, has a tendency to discolour the surface of the castings. (2) Silicon: Silicon is not injurious to copper-tin alloys, since many contain silicon. It becomes very harmful when lead is present and when the melt has not been thoroughly deoxidised and so permits interaction of silicon dioxide and lead oxide to form lead silicate. (3) Aluminium: Aluminium is an extremely dangerous impurity. Even a few hundredths of a per cent. is likely to ruin the alloy, because it makes the castings very unsound. (4) Antimony: Antimony up to 0.25 per cent. does not cause trouble. Its effects on these alloys have not been thoroughly investigated, or at least published results of investigations are scarce. (5) Iron: Free iron, even in small amounts, causes hard spots. Alloyed iron, within the specification, has no pronounced effect on these alloys. (6) Sulphur: Sulphur, in amounts not exceeding 0.08 per cent. is not likely to cause trouble.

Development and Fields of Use

The alloys listed in these recommended practices consist primarily of copper and tin with additions of lead and zinc and sometimes nickel. The alloys without lead machine rather poorly, and, therefore, small amounts of that element are added to improve this property.

Alloy 1A includes those alloys which fall under the nominal composition of 88-10-2 and, together with Alloys 1B and 3, which contain the alloys included under the nominal composition of 88-8-4, are known as gunmetals or "G" bronze.

Alloys 2A and 2B are the leaded tin-bronzes. Alloys 2A and 4 are known commercially as steam or valve bronzes and Navy "M" and have the nominal composition 88-6-2-4. Alloy 2B is a leaded version of the 88-10-2 alloy and sometimes is indicated as 87-10-1-2. Alloys 5, 6 and 7 are for castings for turntables and movable bridges and for bearing and expansion plates for fixed bridges.

The tin-bronzes are used chiefly for bearings which run at high loads and comparatively low speeds, for resistance to corrosion, particularly of sea water, for decorative purposes, statuary and bells. Alloys 1A, 1B, 2B and 3 are used in castings which are subjected to temperatures not exceeding 232 deg. C., while 287 deg. C. is the limiting temperature for Alloys 4 and 2A.

From the above it is evident that these alloys are used in valve and steam fittings and for pump and piston parts where steam is used. The tin-bronze alloys are resistant to sea water corrosion and from dezincification, and the alloy containing the maximum of tin (11 per cent.) and deoxidised with phosphorus is outstandingly satisfactory as a worm-wheel material.

Lead is added to the tin-bronze alloys to form the classification leaded tin-bronzes. The lead is added primarily to improve machinability, and the leaded tin-bronze alloys with under 2.0 per cent. lead have approximately the same mechanical properties as the lead-free alloys. As the tin percentage increases above 11 per cent. to about 14 per cent. and the zinc held to the minimum shown in Alloy 1A, a composition is developed which is used in valve bodies subject to high pressure and vibration, but not high temperature and one which is used considerably in mine service and in the sulphite pulp and paper industry.

As the tin is increased from 15 to 20 per cent. (Alloys 6 and 7) and the zinc reduced to a maximum of about 0.25 per cent., an alloy is produced which is very brittle and which is used extensively for bridge bearings where loads are very high and speeds very low. A 17 per cent. tin alloy is used at loads up to 1,500 lbs. per sq. in. against soft steel. A 20 per cent. tin alloy is used at loads over 1,500 lbs. per sq. in. against hardened steel.

EFFECT OF THORIUM ON CAST IRON

REPORT OF GERMAN RESEARCH

In research on the effect of thorium on grey cast iron, carried out by W. BAUKLOH and H. MEIERLING ("Die Giesserei," March 20, 1942), test melts were prepared in a cupola (capacity 5 tons per hr.) with receiver, and the thorium added as briquettes held down in the charge by a box at the end of an iron rod. Stirring with the rod ensured thorough mixing with the charge. The additions were from 0.2 to 1 per cent. thorium element; larger percentages would have been too costly and would also have introduced metallurgical difficulties, since the melting point of thorium is very high and a relatively high percentage in cast iron would have considerably raised its melting point.

From each melt, four vertical bars, 650 mm. long and 30 mm. dia. were cast, and then tested for transverse strength and deflection. The broken transverse bars were then used for tensile and Brinell tests. Thorium has a high oxygen affinity which caused high melting losses under the conditions of these experiments. Chemical analysis of the finished melts showed that, after pouring, the cast iron contained no thorium.

TABLE I.—*Composition of Testpieces.*

No.	Th added per cent.	Analysis of cast iron.					Brinell value.
		C	Si	Mn	P	S	
				SERIES A.			
1	0.0	3.14	2.99	0.41	0.95	0.15	199
2	0.2	3.18	2.98	0.41	0.95	0.12	199.5
3	0.4	3.18	2.94	0.42	0.93	0.11	200.5
4	0.6	3.14	2.95	0.43	0.94	0.11	199
5	0.8	3.18	2.96	0.45	0.95	0.12	198.5
6	1.0	3.14	2.97	0.45	0.96	0.10	198
				SERIES B.			
7	0.0	3.20	2.76	0.45	0.41	0.12	206.5
8	0.2	3.20	2.80	0.44	0.40	0.11	202
9	0.4	3.20	2.77	0.42	0.42	0.11	203
10	0.6	3.18	2.78	0.43	0.43	0.09	203
11	0.8	3.18	2.76	0.45	0.41	0.10	203
12	1.0	3.20	2.77	0.44	0.41	0.08	200

Data have therefore to be based on the thorium added, especially since thorium, like cerium alloyed metal, exercises predominantly a refining action on grey cast iron. Some graphite refinement also appears to take place, and in making malleable iron thorium slightly accelerates malleablising.

The two mixtures from which test-pieces were prepared consisted of:—A—160 kgs. Deutsch III iron, 25 kgs. 11 per cent. Fe-Si, and 315 kgs. iron scrap; B—140 kgs. foundry No. III iron, 20 kgs. HK iron, 25 kgs. 11 per cent. Fe-Si, and 315 kgs. iron scrap. Analyses of the finished melts and the corresponding Brinell values are given in Table I. The analyses show that the Si, Mn, P and C are practically unchanged, but that with increasing additions of thorium the sulphur is progressively reduced, desulphurisation being closely comparable to that obtained on adding the same amounts of cerium alloyed metal. The thorium seems to improve the transverse strength, the deflection and the tensile strength. On adding 1 per cent. Th, the transverse strength is raised 8.9 per cent. in series A and 6.6 per cent. in series B, the deflection being raised 1 and 2 per cent. respectively. Under the same conditions the tensile strength is raised by 11.2 per cent. in series A and by 8.3 per cent. in series B. Brinell hardness is substantially unchanged by the addition of Th. But with increasing Th the shrinkage of the iron increases, causing a greater liability to porosity at section junctions. The viscosity of the iron improves with additions of between 0.4 to 0.6 per cent. Th, but falls again when more Th is added.

Microscopic examination revealed a more refined graphite in the Th-treated melts; in the range investigated, the iron showed no tendency to solidify white. It is evident that the improvement in tensile and transverse strengths is due to the more refined graphite, produced by the finely divided Th oxide which separates during pouring and provides a nucleus for graphite crystallisation. The improved mechanical properties may also be due to the better degasification of the molten charge, as already suggested by Piwowarsky. Why the iron should have more life is not clear; it may be associated with the gas and the sulphur contents of the iron. At the same time, owing to the high heat of combustion of the Th, the iron on pouring becomes hotter rather than colder. Heat may be evolved not only by reaction of the element Th, but also by its compounds, the sulphide and nitride, which also separate.

CASTING SILVER

According to "The Iron Age," it is possible to fabricate parts made from silver and silver alloys in much the same way that aluminium and brass are worked, namely, by rolling, drawing, stamping, spinning, and the like, as well as by the various machining processes in which the metal is cut by conventional tools. Silver may be welded, and, of course, brazing and silver soldering are accomplished with relative ease. Since oxidation does not take place readily up to the melting point, it is even possible to use the gas-air blowpipe if a small amount of flux be employed. Silver can be readily cast by the following means: A pattern or model is made from wax and to it are attached sprues of the same material. Then a mixture of plaster of Paris, ground silica, and water is cast around the pattern and is allowed to set until the mould becomes hardened. A recess is then cut in such a way that it connects with the holes formed by the sprues, and the wax is run out. Molten silver or silver alloy is then run into the cavity which, of course, has the shape of the pattern. Flow of the metal is facilitated by evacuating the cavity or by applying pressure to the molten alloy either by centrifugal means or by air. The mould is broken to remove the casting.

If several identical castings are required, the wax patterns can be duplicated in any desired quantity in a metal mould made for the purpose. Articles weighing up to 2 ozs. are said to be made by this method in commercial quantities, for various industrial applications.

MOULDING A CAST-IRON BASE

By W. Gudgeon

When studying the drawing for the purpose of moulding the casting shown in Fig. 1, it will be seen that the design of the pattern calls for special provision when settting the core in the print. This provision arises from the fact that an unusually large fillet or corner connects the 3-ft. by 9-in. square plate to the tapered body of the casting with a corresponding fillet at the top of the core. The result is that when the core is being lowered into position it completely obscures the bottom of the mould before it finally settles into its print. Under these circumstances, if the bottom of the mould were made in green sand, it would constitute a serious disadvantage for the moulder as it would be difficult to guide the core into its exact position without the danger of a "crush." To overcome this doubtful operation the bottom of the mould was formed with oil-sand cores and the risk of a "crush" removed.

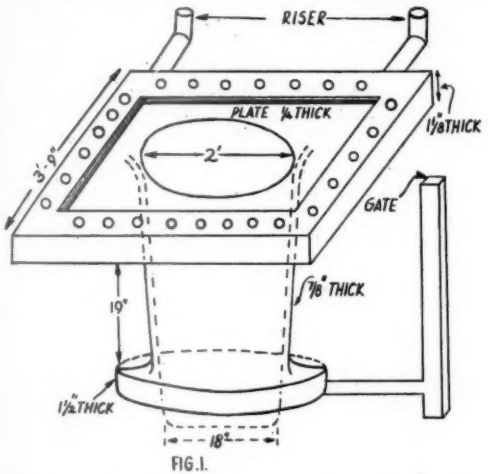

FIG.1.

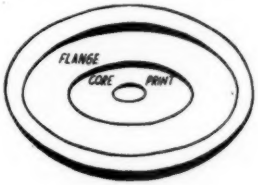

FIG.3.

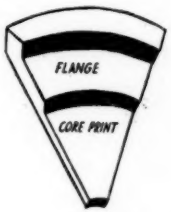

FIG. 2.

FIG.6.

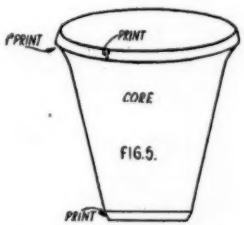

FIG.5.

The operations of moulding the casting are as follow: A very hard level bed is made in the floor. Two straight-edges and a third one for strickling off the surplus sand is employed or, alternatively, a spindle and board may be used. Four sections of cores, one of which is shown in Fig. 2, combining core print and mould for the flange, are fitted together on the level bed, the four cores when joined to each other forming the mould base indicated in Fig. 3. The flange, 3 in wide by 1½ in. thick, is placed in the mould. It is made in five parts, which are withdrawn inwards when the pattern body has been removed.

The body is then lowered in the print and the flange covered with four cores similar to the one shown in Fig. 4. The ingate is then put in position, the molten iron entering the mould by way of the flange. The ingate also consists of a core with a loose downgate attached. Sand is then rammed up to the top of the tapered body and prepared to receive the square part of the pattern. This preparation requires a level surface which is secured by placing a straight-edge on top of the pattern and using it as a guide to strickle off the loose sand. The surface is then well vented, these downward vents afterwards connected with side vents pierced from the joint before the pattern is withdrawn.

It is important that no scabbing takes place underneath the plate as the raised part or pad with the holes in is machined. After the top and middle part of the pattern has been withdrawn the five sections of the flange are taken out, this proving quite an easy operation. When lowering the core (Fig. 5) into position, and about 3 in. from the bottom, its approximate centre in the mould is ascertained by a two-foot rule, thus ensuring a direct entry into the print. A final check-up for centre of core in mould is then made, which in this case must be accurate, as the 1-in. print in the top part of the mould, and shown on the body core, must register correctly when the mould is closed, otherwise the core will scrape the side of the mould when the top is lowered over it.

The reason for the top print is to give stability in handling what, without it, would be a feather-edge all round the top of the core. The twenty-eight 1-in. holes in the top plate are made with the aid of a template shown in Fig. 6, thus doing away with core prints on the pattern. The template is laid on the mould and a thin tube is forced through each hole to make a print to the required depth. The cores are then inserted. A number of castings were made from this pattern and the method of moulding described above was found in every way satisfactory. The weight of the casting was 6 cwts.

ALLOY EQUILIBRIUM DIAGRAMS

No. 2 in the Institute of Metals' Monograph and Report Series, entitled "Bibliography of the Literature relating to the Constitution of Alloy Equilibrium Diagrams," by Dr. J. L. Haughton, should be available about the beginning of October. The bibliography has now been brought up to date and includes references to all constitutional Papers seen up to the time of going to press. The monograph, which is bound in a limp green cover, consists of 163 pages and contains approximately 5,500 references to the constitution of binary, ternary, and higher alloy systems, ferrous and non-ferrous. The price of the monograph is 3s. 6d., post free, but all members, student members and associate members of the Institute will be entitled to receive one copy free of charge on application by postcard to the Secretary. Members who have already applied need not make fresh application.

CATALOGUES RECEIVED

Aluminium Nickel Silicon Brass.—Enclosed in a neat folder carrying a pocket, the Tungum Sales Company, Limited, of Brandin House, Painswick Road, Cheltenham, has just issued four data sheets covering the properties of "Tungum" alloy for castings, solid-drawn tubing, rods and bars, sheet and strip, and wire. The alloy is finding many useful applications in both the marine and aircraft industries, as it is both non-magnetic and non-corrosive. This group of brochures, which is available to our readers on application to Cheltenham, is outstanding, as both the chemical composition and the physical properties are given of a proprietary alloy. It is a step which will be appreciated by the industry and, moreover, it will increase consumption rather than the reverse.

Handling Caustic Soda.—Imperial Chemical Industries, Limited, of Nobel House, London, S.W.1, have sent us a copy of "Dissolving Caustic Soda and Handling Its Solutions." It is an interesting publication, thoroughly practical in character, and gives detailed instructions as to how to open the casks; to make strong solutions; and to dispose of the residues. There are also notes on the caustic embrittlement of steel, protective clothing, and first-aid treatment for injuries.

Institute of Marine Engineers' Examinations

The next examinations for admission to the Institute of Marine Engineers will be held as follows:—Students (common preliminary examination), April 6 to 9 and October 5 to 8, 1943; Graduates (Section A of associate membership examination), May 31, June 2 and 4, 1943; Associate members, May 31 to June 7, 1943. Syllabuses of these examinations, copies of previous Papers, and particulars of exempting qualifications, will be supplied on application to the Secretary, at 73, Amersham Road, High Wycombe, Bucks.

NEWS IN BRIEF

WHOLESALE PRICES IN AUGUST, as measured by the Board of Trade index number, were 0.7 per cent. lower than in July.

ASTBURY SILICA COMPANY announce a change of address from The Brooms, Park Lane, to Albert Chambers, Congleton, Cheshire.

REDLER EQUIPMENT, LIMITED, has been registered as a public company with a capital of £110,000 to acquire the issued share capital of Redler Conveyors, Limited, Dudbridge Works, Stroud, Gloucestershire.

MR. ARTHUR CHERINGTON, progress clerk in the employ of L. Sterne & Company, Limited, engineers, Crown Ironworks, North Woodside Road, Glasgow, has been presented with a gold watch by the directors, on having completed 25 years' service without being absent for a single day.

STAGGERING of starting hours in Clydeside works to relieve transport congestion is proposed. The scheme, confined meantime to the north side of the river between Glasgow and Dalmuir, has been approved by the Transport Committee of the Clyde Confederation of Shipbuilding and Engineering Trade Unions, and is being put before the workers by the trade union officials. It is hoped, if the plan is approved, to bring it into operation next month.

THE ESSENTIAL WORK (Iron and Steel Industry) Order, 1941, contained a schedule of agreements for the purpose of ascertaining the appropriate agreed wage of specified persons in scheduled undertakings in the iron and steel industry. A new Order just published (No. 3, 1942, S.R. & O., 1747) adds another agreement to the schedule, the parties to it being the Glamorgan Hematite Iron Ore Company, Limited, and their workmen employed at Llanharry Mine, near Pontyclun, Glamorgan.

IN A RECENT STATEMENT BEFORE a sub-committee of the Senate Committee of Agriculture, in connection with the American synthetic rubber programme, Mr. Donald M. Nelson stated that the programme would divert essential metals from highly important wartime industries. The present 800,000-ton synthetic rubber programme calls for 122,000 tons of steel plate, 210,000 tons of other steel and more than 7,000 tons of copper, bronze and brass. This demand for steel plates would mean a serious diversion from the shipbuilding industry, tank manufacturers and other essential war industries.

THE TEES VALLEY WATER BOARD has invited the treasurers of the Middlesbrough, Stockton and Thornaby Corporations, the three constituent authorities, to confer on the matter of water charges to industries. It was reported recently that a letter had been received from the Iron and Steel Trades Employers' Association, acting as intermediary for the large consumers, stating that full consideration had been given to a statement put forward by the Board, and they had come to the conclusion that this did not justify them in acceding to the Board's request for a voluntary increase in the scale of water charges.

COMPULSORY DISCLOSURE OF SCRAP METAL

REQUIREMENTS OF NEW ORDER

The Minister of Works and Planning has made an Order under the Defence Regulations under which occupiers of all premises in England, Scotland and Wales on which there are three or more tons of metal suitable for scrap, must inform the Ministry within 30 days of September 21. Returns must also be made within 30 days of any subsequent day on which such an amount of metal is so accumulated. Metal is deemed suitable for scrap if it is any metal—ferrous or non-ferrous—other than aluminium or magnesium or their alloys, which is, or forms part of, any building, structure, plant or article which is disused, obsolete or redundant, or otherwise serving no useful purpose. "Premises," for the purpose of the Order, means any building or land which has an assessment under Schedule A, or which is subject to a valuation for rating.

The information must be made on a prescribed form, which may be obtained from "Scrap Recovery," Ministry of Works and Planning, Sanctuary Buildings, Great Smith Street, London, S.W.1.

The new Order is an extension of an Order made on May 14 last, calling for an identical return from premises in the London Civil Defence Region, Essex, Dorset, Nottinghamshire, Monmouthshire, East, West and Mid-Lothian, and the county boroughs of Bristol and Leeds. If a return has already been made from premises in these areas, another return need not be made under the new Order. There are three sections to the return:—(*a*) Loose scrap; (*b*) fixed scrap, machinery, plant, etc.; and (*c*) reserve or standby plant.

Firms Closed Under Concentration Schemes

While the Order necessarily calls for returns in respect of machinery and plant which is disused or serving no immediate purpose, this does not mean that there is any intention to take as scrap valuable machinery and plant which it is important to preserve for post-war use. In particular the Order does not call for a return of machinery or plant belonging to firms that have closed down under schemes of concentration approved by the Board of Trade or the Ministry of Food, and there is no question of such machinery or plant being requisitioned. No machinery or plant will be taken against the will of the owner without right of appeal, and the Board of Trade will be consulted in appropriate cases before such appeals are determined.

Returns are not required where:—(*a*) The metal forms part of those machine tools specified in the first schedules to the Control of Machine Tools (No. 9) Order and the Control of Machine Tools (Cutting Tools) (No. 1) Order, 1942, or in any Orders replacing or amending them. (*b*) Returns have already been made to the Iron and Steel Control under the Industry (Records and Information) No. 1 Order, 1940, or No. 2 Order, 1941.

(*Continued at foot of next column.*)

(*Continued from previous column.*)

It is the occupier of premises who has to make the return, whether or not he owns the metal. In the case of empty premises, it is the person who is entitled to occupy those premises who has to make the return.

IRON AND STEEL CONTROL

APPOINTMENT OF DEPUTY-CONTROLLER

The Ministry of Supply have announced the appointment of Mr. George Briggs as Deputy-Controller in charge of Iron and Steel Supplies. He succeeds Sir John Duncanson, the newly-appointed Controller. In his new post Mr. Briggs will be directly responsible for the supply of iron and steel products to all the war industries. Mr. Briggs, who has been with the Iron and Steel Control since the outbreak of war, has been responsible for the production of alloy and special steels, steel castings, forgings and ferro-alloys. He has successively held the posts of Director for Alloy and Special Steels and Assistant Controller of Iron and Steel Supplies. Prior to the outbreak of war Mr. Briggs was special director of the English Steel Corporation, Limited, and a director of the Darlington Forge, Limited.

OBITUARY

MR. OTTO MUELLER, managing director of the Pressed Steel Company of Great Britain, Limited, died at Oxford recently at the age of 53. He was an American.

MR. EDWARD ALBERT DAVIES, who for 50 years was chairman of Davies Bros. & Company, Limited, structural ironwork manufacturers, etc., of Wolverhampton, died recently. He was 84 years of age.

MR. JOSEPH HEATON SOUTHERN, managing director of Richard Hill & Company, Limited, wire drawers, Middlesbrough, died suddenly at his home at Redcar last week. Two years ago he was elected a member of the Redcar Town Council and became vice-chairman of the Parliamentary Committee. He was a well-known and popular figure in North-East Coast industrial circles.

KEEPING UP-TO-DATE IN A.R.P.

Industrial Bulletin No. 2, prepared by the Ministry of Home Security, has been published by the Stationery Office. These bulletins, which contain information obtained under raid conditions, are intended to assist industry and commerce to keep their air-raid precautions schemes up-to-date in Civil Defence technique. They are for sale on a restricted basis. Copies can be obtained, price 9d. each, on written application to H.M. Stationery Office, York House, Kingsway, London, W.C., by the principals of public-utility companies or industrial or commercial concerns.

COMPANY NEWS

(Figures for previous year in brackets.)

A. Reyrolle & Company—Interim dividend of 5% (same).

Halesowen Steel Company—Interim dividend of 7½% (same).

British Aluminium Company—Ordinary interim dividend of 3% (same).

Watford Electric & Manufacturing—Interim dividend of 5% (same).

Coltness Iron Company—Interim dividend of 9d. per 15s. ordinary share (same).

Barton & Sons—Final dividend of 3½% on the ordinary shares, making 6% (5%) for 1941.

Worthington-Simpson—Interim dividend on the 6% cumulative preference shares in respect of the half-year ended June 30.

W. H. Dean & Son—Net profit, after tax, for the year to August 12 last, £23,909 (£35,051); ordinary dividend of 20% (same).

Leeds Fireclay—Net profit for the year ended June 30, £10,877 (loss £9,208); debenture interest, £8,684; forward, £25,958 (£23,765).

Aluminium Corporation—Profit for 1941, after depreciation and E.P.T., £45,575 (£46,637); loan interest, £4,000 (£4,535); interest on income debentures for 1936, £10,500 (same); directors' fees, £2,400 (£2,586); to income-tax, £25,250 (£28,500); forward, £9,305 (£6,080).

International Aluminium—Profit for 1941, after amortisation, reserve against stocks, and N.D.C., £19,506 (£20,791); directors' fees, £2,400 (£2,833); income-tax, £3,000 (£2,600); dividend on preference shares for 1941, £17,374 (same); forward, £13,938 (£17,207).

Qualcast—Profit for the year to June 30, £159,787 (£99,587); directors' fees, £2,888 (£3,150); A.R.P. expenditure, £8,289 (£11,293); war damage payment, £1,362 (£3,103); income-tax and E.P.T., £120,348 (£46,434); final dividend of 10%, plus cash bonus of 10%, making 30% (same); forward, £30,262 (£29,475).

Darlington Railway Plant & Foundry Company—Trading profit for the year to April 30 last, £8,185; other income, £230; depreciation, £1,742; reserve for taxation, £2,000; net balance, £4,733; to general reserve, £2,000; dividend on the 5% preference shares, £325; dividend of 10% on the ordinary shares, £2,100; forward, £3,126 (£2,818).

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

MacDonald & Company (Haydock), Empress Works, Penny Lane, Haydock, Lancs—Ironfounders, etc. £5,000.

Arches Foundry, G.W.R. Sidings, Wood Lane, Shepherds Bush, London, W.12—£500. W. and E. H. Martin.

PERSONAL

MR. ARTHUR EDGAR WILKES, of Pelsall, Walsall, has been appointed a Justice of the Peace for Staffordshire. He is a member of the firm of Ernest Wilkes, engineers and ironfounders, of Pelsall.

WE LEARN THAT Lieut. P. B. Lake, son of Mr. W. B. Lake, governing director of Lake & Elliot, Limited, steel and iron founders, of Braintree, Essex, is a prisoner of war in Italian hands.

MR. JAMES L. KENT is to be superintendent of the William Froude Laboratory of the National Physical Laboratory, Teddington, in succession to Dr. C. S. Baker, who is retiring to-morrow (Friday). Mr. Kent went to the William Froude Laboratory in 1910 and was appointed principal scientific officer about ten years ago.

MR. HERBERT JOHN BARLOW has been appointed a Justice of the Peace for Staffordshire. Mr. Barlow is managing director of H. J. Barlow & Company, Limited, Wednesbury, a member of the Bright Steel Bar Association and the Conduit Tubes Association. He is also connected with various other concerns in the Black Country, chiefly in the iron, steel and kindred trades.

MR. B. E. WILLIAMS, on retirement from business, relinquishes the appointment of joint managing director of Turner & Newall, Limited, as from October 1, but remains an ordinary director of the company. Mr. W. W. F. Shepherd, at present joint managing director, becomes deputy chairman. Messrs. H. Hanson, R. Gray Soothill, and G. Wilson, all of whom have been associated with the company for many years, are appointed directors.

Wills

SUREN, J. H. T. E., senior partner in E. Suren, metal merchants, London £68,482

RANDELL, F., formerly chairman and managing director of F. Randell, Limited, agricultural engineers and ironfounders, North Walsham, Norfolk £21,939

EXPORT LICENSING

Under the Export of Goods (Control) (No. 38) Order, 1942, which comes into force on September 28, licences will, in future, be required to export thermite to all destinations. Licences will similarly be required to export cotter, grooved and taper pins made wholly or mainly of iron and steel.

The existing licensing requirements with respect to ball and roller bearings and parts thereof, and plummer blocks, brackets, hangers and pedestals, incorporating such bearings, are superseded by the provision that licences will, in future, be required to export.

COMMERCIAL DIRECTORSHIP OF THE BRITISH IRON AND STEEL FEDERATION

At a meeting of members of the British Iron and Steel Federation held in London last week, it was reported that Mr. I. F. L. Elliot, who had been commercial director of the Federation and managing director of the British Iron and Steel Corporation since November, 1935, had ceased to hold those offices.

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Raw Material Markets

IRON AND STEEL

There is still a disposition on the part of many foundrymen to refrain from buying their pig-iron requirements ahead until the plans for the concentration of the trade in their particular district has been announced. This applies, of course, to the light-foundry trade, which is quietly employed on the whole. A number of these foundries will be closed down; in fact, in the London area, where the details of the concentration scheme have been issued, some works have already shut their doors. Those foundries which are classed as nucleus works are entering the market for substantial tonnages of iron, as they will be busier than they have been for a long time past in view of the fact that they will be required to take on orders which would have been placed with foundries which have been shut.

Supplies of high-phosphorus iron are being delivered to points of consumption very satisfactorily, and there is no sign of any shortage with regard to this type of iron, as it is produced from ores located in the United Kingdom. Hematite, low-phosphorus iron and other better qualities, however, are extremely difficult to obtain, especially the former, and the Control authorities give very careful consideration to all applications for licences to purchase fresh supplies before they grant the necessary permits. Available supplies are reserved for users engaged on really important orders, and even these consumers have to make use of alternative grades where possible.

The heavy engineering foundries and works catering for the requirements of the machine-tool makers, etc., are still operating at a brisk rate, and most of these speciality foundries have full order-books which extend over some time ahead. In view of the urgent demand for heavy castings, it is certain that business in this section of the industry will remain active for the duration of the war.

There are adequate supplies of coke for foundry use and large stocks are on hand at many points where the necessary accommodation is available. Smaller users whose facilities for laying down reserves are limited are also receiving prompt deliveries week by week. The Control quotation for Durham best foundry coke, delivered Birmingham and Black Country stations, is 69s. 3d. per ton. A rise-and-fall clause is included in all contracts, so that, in the event of a change being made in the official price, buyers and sellers are covered against loss.

Producers of high-grade steels for aircraft and other manufacturers have very full order-books, and output is constantly being enlarged to cope with the needs of the new plants which are regularly being brought into commission. Medium sizes of joists, angles and channels are being taken up freely once more, and the mills have sufficient work on hand in most instances to keep them occupied well into the next period. Shipbuilders continue to make insistent calls on the resources of the plate mills, while there are considerable demands for plates from the wagon, tank and other heavy industries. Makers of bright-drawn steel are in possession of large orders, while the steel requirements of the collieries are maintaind at a high level.

NON-FERROUS METALS

Urgent war demands for copper continue to be met satisfactorily, and the supply situation generally seems to be quite favourable. Large tonnages of scrap copper and brass are being collected, which is all to the good, as the more scrap that can be utilised the greater the amount of shipping that can be released to carry more vital cargoes than copper. Shipments of the red metal are coming into United Kingdom ports regularly, and considerable reserve stocks are on hand, so that essential requirements are assured of being satisfied promptly for some time to come.

The forward tin situation, while not giving any cause for complacency, is better than many considered it would be after the Japanese conquests in the Far East. Strict economy must continue to be made in its use, but there is no reason to believe that supplies of tin will fall short of the requirements of consumers engaged on war work.

It is understood that producers of metals other than gold in Australia will receive considerable concessions under a new income-tax Bill which is at present before the Commonwealth Parliament. Generally 20 per cent. of profits derived from metal mining will be exempt from taxation, but in cases of large increases in output to meet war requirements a higher rate of exemption can be granted through a Board of Referees. Since the Japanese threat to Australia increased the Government has taken steps to enlarge the production of vital metals, including copper and tin. High-cost producers of both metals receive certain sums from a central fund, accumulated through the retention of a part of the increased selling prices, for development purposes. Chiefly due to competition from low-cost producers on the world market, production of copper and tin in Australia in recent years has been very much lower than it was at the outbreak of the last war.

There is no shortage of spelter for urgent war purposes, but other consumers are not getting very liberal allocations, and the use of zinc for a number of purposes has been eliminated. Lead, also, is being used sparingly, and substitutes are ordered for certain purposes. While quite large tonnages are being used for war purposes, many normal users of lead are now quietly employed.

HALE & HALE (TIPTON), LIMITED, malleable iron founders, have purchased the business and premises of J. & J. Whitehouse, Limited, Phœnix Foundry, Tipton. Messrs. Whitehouse have been producing mainly grey-iron hollow-ware for export and it is the intention of the purchasers to change over immediately to other work.

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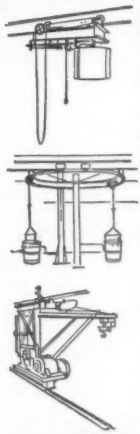

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